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TEMPORARY INSTRUCTION BOOK

MODEL 1010-A

COMPARISON & LIMIT BRIDGE

9290

FREED TRANSFORMER CO., INC.
INSTRUMENT DIVISION

INSTRUCTION MANUAL

FREED TRANSFORMER CO., INC.
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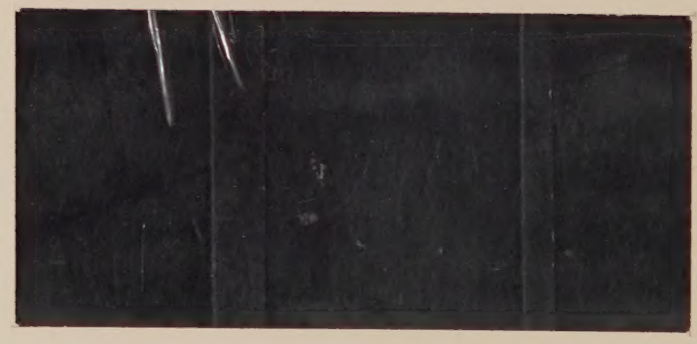

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FREED TRANSFORMER CO., INC.
INSTRUMENT DIVISION

FREED MODEL 1010-A
COMPARISON BRIDGE

USES

THIS INSTRUMENT IS A COMPARISON AND LIMIT BRIDGE FOR USE IN BOTH LABORATORY AND PRODUCTION TESTING OF RESISTORS, CONDENSERS AND INDUCTORS. THE MANUFACTURER OF THESE COMPONENTS CAN USE IT FOR PRODUCTION TESTS, THE USER, FOR INCOMING INSPECTION AND ACCEPTANCE TESTS. THE INSTRUMENT IS PARTICULARLY USEFUL FOR LABORATORY WORK (BRIDGE OR FILTERS) WHERE VERY ACCURATE COMPONENTS ARE REQUIRED.

FEATURES

FOR PRECISION AND PRODUCTION TESTING, THE BRIDGE HAS MANY ADVANTAGES. POWER LINE OPERATION AND THE VISUAL INDICATOR MAKE THE INSTRUMENT COMPLETELY SELF-CONTAINED. IT CAN BE USED IN NOISY LOCATIONS. ITS SMALL SIZE AND LIGHT WEIGHT PERMIT THE INSTRUMENT TO BE MOVED EASILY AND TO BE SET UP WHEREVER NECESSARY.

DESCRIPTION

THE INSTRUMENT IS COMPOSED OF AN OSCILLATOR, A BRIDGE AND A SELECTIVE AMPLIFIER. THE OSCILLATOR OUTPUT IS COUPLED INTO THE BRIDGE THROUGH A SHIELDED ISOLATION TRANSFORMER. A SWITCH IS PROVIDED WHICH CONNECTS EITHER A HIGH OR LOW IMPEDANCE WINDING ACROSS THE BRIDGE, CONSISTING OF TWO FIXED RESISTORS, THE UNKNOWN IMPEDANCE AND THE STANDARD. A VARIABLE RESISTOR BETWEEN THE TWO FIXED RESISTORS MAKES IT POSSIBLE TO READ THE PERCENTAGE DIFFERENCE BETWEEN THE UNKNOWN AND THE STANDARD ON A SPECIALLY CALIBRATED DIAL. A HIGH GAIN SELECTIVE AMPLIFIER INDICATES THE BALANCE OF THE BRIDGE. THE GENERAL METHOD OF TESTING IS THE COMPARISON OF AN UNKNOWN COMPONENT WITH A STANDARD COMPONENT OF THE SAME TYPE. ACCURATE PERCENTAGE MEASUREMENTS ARE OBTAINED BY THE USE OF PRECISION COMPONENTS IN THE ARMS OF THE BRIDGE. THE USE OF HIGH GAIN AMPLIFIER AND ADEQUATE INTERNAL SHIELDING ASSURES A VERY SHARP AND DISTINCT BALANCE.

A VISUAL NULL INDICATOR, CONSISTING OF A METER USED IN CONNECTION WITH THE HIGH GAIN AMPLIFIER MAKES IT POSSIBLE TO USE THE No. 1010-A BRIDGE AS A PRECISION LIMIT BRIDGE IN PRODUCTION TESTING.

SPECIFICATIONS

FREQUENCY

THREE FREQUENCIES ARE AVAILABLE: 50 OR 60 CYCLES, 1000 AND 10000 CYCLES. THE 50 OR 60 CYCLES ARE TAKEN FROM THE LINE. THE 1000 AND 10000 CYCLES ARE GENERATED BY AN OSCILLATOR AND ARE ACCURATE TO WITHIN ±2%.

RANGE (DEVIATION)

Two comparison ranges are provided: 5% and 20%. The percentage difference is read directly on a calibrated dial.

RESISTOR MEASUREMENTS

Resistors from 1 ohm to 10 megohms may be compared at 60 cycles.

CONDENSER MEASUREMENTS

Condensers from 50 mmfd to 10 mfd are measured at 1000 cycles. Condensers above 10 mfd are measured at 60 cycles. Condensers below 50 mmfd may be measured if the ground-unground switch is in the unground position.

INDUCTOR MEASUREMENTS

Inductors may be measured at 60, 1000 or 10000 cycles depending on their value. Range: 10 microhenries to 1000 henries.

ACCURACY

On the 5% position the components can be adjusted to a tolerance of ±0.1%.

VOLTAGE APPLIED TO THE UNKNOWN

Two controls are provided to vary the voltage across the unknown. A special low impedance winding is used when measuring small impedances and the voltage across these may be voried from 0.1 to 1 volts. For higher values of impedance the voltage may be varied from 0.5 to 15 volts.

POWER SUPPLY

105 - 125 volts, 50-60 cycles.

TUBE COMPLEMENT

The following tubes are required and supplied with the instrument: 1-6X4, 1-6AQ5, 1-12AX7, and 2-12AU7.

CABINET

Portable cabinet of all metal construction.

DIMENSIONS

8 1/2" x 11" x 12 1/2" H.

NET WEIGHT

21 pounds.

CONTROLS

ALL THE CONTROLS FOR THE OSCILLATOR, BRIDGE AND AMPLIFIER ARE LOCATED ON THE FRONT PANEL; THESE CONTROLS ARE:

OSCILLATOR GAIN- THIS CONTROL VARIES THE VOLTAGE LEVEL ACROSS THE COMPONENTS UNDER TEST. [R-4]

LEVEL- IN THE "HIGH" POSITION THE TEST VOLTAGE APPLIED TO THE COMPONENTS UNDER TEST MAY BE VARIED FROM .5 TO 15 VOLTS. IN THE "LOW" POSITION THE MAXIMUM VOLTAGE IS 1 VOLT. THE "LOW" POSITION IS ESPECIALLY USEFUL WHEN MEASURING IMPEDANCES BELOW 10 OHMS SINCE THE OUTPUT IMPEDANCE OF THE BRIDGE TRANSFORMER IS 2 OHMS. IN THE "HIGH" POSITION THE IMPEDANCE IS 500 OHMS. [S-2]

TEST FREQUENCY- THREE STANDARD FREQUENCIES ARE AVAILABLE: 60 CYCLES, 1000 CYCLES AND 10000 CYCLES. IN THE 1000 CYCLE AND 10000 CYCLE POSITIONS SELECTIVE FILTERS ARE CONNECTED INTO THE AMPLIFIER. [S-1]

AMPLIFIER GAIN- THE GAIN OF THE AMPLIFIER IS ADJUSTED BY THIS CONTROL. [R-15]

BRIDGE- IN POSITION "1" THE BRIDGE IS CONNECTED IN THE CONVENTIAL MANNER AND THE LOWER TERMINALS OF THE "STANDARD" AND "UNKNOWN" ARE GROUNDED. IF EXTREMELY LARGE INDUCTORS OR HIGH IMPEDANCES ARE TO BE MEASURED INACCURACIES WILL RESULT BECAUSE OF THE STRAY CAPACITIES ACROSS BOTH THE "STANDARD" AND "UNKNOWN" TERMINALS. TO REDUCE THIS ERROR THE OPPOSITE VERTEX OF THE BRIDGE IS GROUNDED IN THE "2" POSITION OF THE "BRIDGE" CONTROL. [S-3]

% DEVIATION- THE POSITIONS 5% AND 20% CORRESPOND RESPECTIVELY TO THE COMPARISON RANGE BETWEEN THE UNKNOWN AND THE STANDARD. [S-4]

OPERATING INSTRUCTIONS

THE INSTRUMENT IS READY TO OPERATE AS RECEIVED. TURN THE POWER SWITCH TO THE ON POSITION AND ALLOW A FEW MINUTES WARM-UP PERIOD. THE INSTRUMENT SHOULD BE GROUNDED IN ORDER TO DECREASE THE HUM LEVEL. THE GROUND CONNECTION SHOULD BE MADE TO THE BINDING POST LOCATED IN THE REAR OF THE CABINET. IN SOME LOCATIONS IT MAY BE NECESSARY TO REVERSE THE POWER LINE PLUG TO OBTAIN A MINIMUM HUM LEVEL.

MEASUREMENT OF RESISTORS BY THE COMPARISON METHOD

CONNECT THE STANDARD RESISTOR ACROSS THE TERMINALS MARKED L-R STANDARD, THEN SET THE "TEST FREQ" SWITCH TO THE 60 CYCLE POSITION AND THE "OSCILLATOR GAIN" TO MID-POSITION. THE "AMPLIFIER GAIN" CONTROL SHOULD BE ADJUSTED SO THAT THE NULL INDICATING METER READS ON L SCALE. THE "SET LEVEL" SWITCH SHOULD BE IN "HIGH" POSITION, [UNLESS RESISTORS BELOW 10 OHMS WILL BE COMPARED] "BRIDGE" CONTROL SHOULD BE IN POSITION 1.

NOW CONNECT THE STANDARD AND UNKNOWN RESISTORS ACROSS THE APPROPRIATE TERMINALS AND MOVE THE "% DEVIATION" DIAL UNTIL A MINIMUM READING IS OBTAINED ON THE METER. TO GET A SHARPER NULL THE AMPLIFIER GAIN MAY BE INCREASED. THE EXACT PERCENTAGE DIFFERENCE MAY NOW BE READ FROM THE DIAL AND THE PERCENT DEVIATION SWITCH. IF THE READING IS ON THE POSITIVE SIDE OF THE DIAL THE UNKNOWN IS LARGER THAN THE STANDARD BY THE PERCENTAGE INDICATED ON THE DIAL.

HIGH RESISTANCE MEASUREMENTS

SPECIAL PRECAUTIONS MUST BE TAKEN WHEN MEASURING HIGH VALUES OF RESISTORS (ABOVE 1 MEGOHM). THE INSTRUMENT SHOULD BE PROTECTED FROM EXTERNAL FIELDS AND THE UNIT SHOULD BE GROUNDED. THEN CONNECT TWO EQUAL RESISTORS ACROSS THE X AND STANDARD TERMINALS AND SET THE % DEVIATION DIAL TO ZERO. THEN ADJUST THE "C" BALANCE UNTIL THE NULL INDICATING METER READS A MINIMUM. THIS BALANCES THE STRAY CAPACITANCE ACROSS THE X AND STANDARD TERMINALS AND THE CAPACITY OF ANY EXTERNAL TEST LEADS. THEN PROCEED AS BEFORE IN MAKING THE RESISTOR MEASUREMENT.

WHEN MEASURING RESISTORS ABOVE 5 MEGOHMS, STRAY CAPACITANCE ACROSS THE COMPONENTS UNDER TEST CAN BE KEPT TO A MINIMUM BY SETTING THE "BRIDGE" SWITCH TO POSITION "2". IN THIS POSITION OF THE SWITCH THE COMPONENTS UNDER TEST ARE ABOVE GROUND, AND THE VARIABLE ARM IS GROUND SO THAT ALL CAPACITIES TO GROUND ARE ACROSS THE LOW IMPEDANCE FIXED RESISTANCE ARMS OF THE BRIDGE.

LOW RESISTANCE MEASUREMENTS

FOR BEST RESULTS WHEN MEASURING RESISTORS BELOW 10 OHMS THE "LEVEL" SWITCH SHOULD BE IN THE "LOW" POSITION

MEASUREMENT OF RESISTORS USING THE BRIDGE AS A LIMIT BRIDGE

When using this instrument as a limit bridge connect the standard resistor across the "Std" terminals and connect a resistor whose percentage difference from the standard is known across the R unknown terminals. Set the % Deviation dial at 0. Adjust the oscillator level and amplifier gain until the meter reads about 4. The limit bridge is then calibrated.

Connect the resistors to be tested across the unknown terminals leaving the standard across the "Std" terminals. All the unknown resistors that will cause a deviation of the meter equal or less than the present deviation are within tolerance. The deviation of the meter can also be calibrated as a function of the percentage difference. In that case the instrument would not only indicate whether the unknown is within the tolerance but also by what percentage it differs from the standard. To accomplish this, several known resistors should be tested and the meter calibrated. To determine whether the unknown resistor is larger or smaller than the standard, get a null and move the % dial to the left or right. If the meter reading decreases when the % dial is on the plus side, the unknown is larger than the standard.

CONDENSER MEASUREMENT

The procedure in measuring condensers is similar to that used in resistor measurement. Condensers up to 10 mfd should be measured with the test frequency switch in 1KC position. All other switches are in the same position as in making resistor measurements. i.e. Oscillator gain in midposition, "Level" switch in "High" position and "Bridge" in position 1. When measuring capacitors below 500 mmfd the "C" balance should be made as described under ,high resistor measurement. For measuring capacitors below 100 mmfd the "Bridge" switch should be in position 2.

INDUCTANCE MEASUREMENTS

Inductors are measured at 60 cycles, 1000 cycles and 10KC depending on their values.

From 10 microhenries to .1 henry at 10KC
From .1 henry to 100 henries at 1KC
From 100 henries to 1000 henries at 60 cycles

Inductors are measured using the same procedures as outlined for resistor measurements.

When measuring inductances above 100 henries the"Bridge" switch should be in position "2". When measuring inductors below 100 microhenries the level switch should be in the low position.

OPERATING NOTES

1. This instrument does not measure absolute values of L or C but compares impedances. Therefore the power factor of a condenser or the Q of a coil cannot be measured directly.

2. Since the bridge compares impedances, it is desirable to use a component similar to those being tested as a standard. A standard precisely at the desired value may not be available, in that case use the offset zero provided on the bridge and offset the zero to correspond to the deviation of the standard component form the desired nominal value. Thus if ±1 percent resistors are being sorted and the available standard is off ±.4 percent, the bridge zero can be offset exactly .4 percent and the resistors checked as if a perfect standard were available. (To offset zero loosen knurled screw on upper indicator) In order to readjust the zero of the dial, turn the % Deviation dial until the lower indicator is aligned with the centering mark, then loosen knurled screw and move upper indicator until it is over the 0% deviation mark.

SERVICING

1. Vacuum Tube Voltmeter Zero Adjustment- This adjustment should be made when the 12AU7 in the Null Detector Amplifier is replaced. To adjust set Oscillator Gain and Amplifer Gain to zero, and adjust zero adjust until the meter reads zero. The adjustment is located on the inside of the cabinet just below the pilot light.

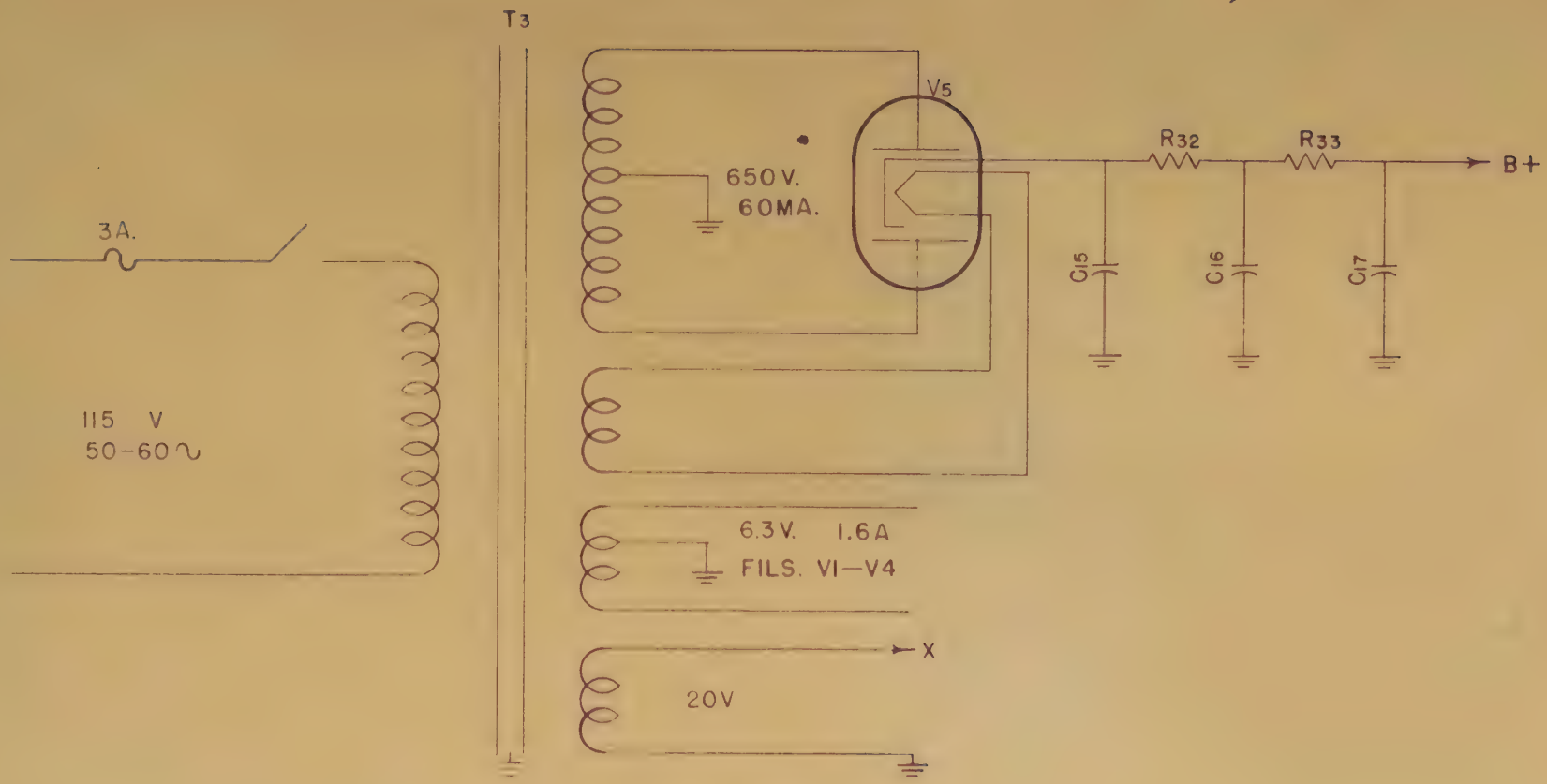
2. It is extremely important that the knob be tightly coupled to the % Deviation Potentiometer. The two set screws should be tightned periodically. To determine whether the knob and dial are in the proper position set % Deviation dial so that lower indicator is on the centering mark. Then connect two identical resistors across the Std and Unknown terminals and obtain a balance, with "% Deviation" switch on 5% position. Since the two resistors are identical the dial indication should be zero. If not loosen set screws in knob and turn dial until the null indication and the zero reading on the dial occur simultaneously.

CONTROL SETTINGS FOR 1010-A COMPARISON BRIDGE

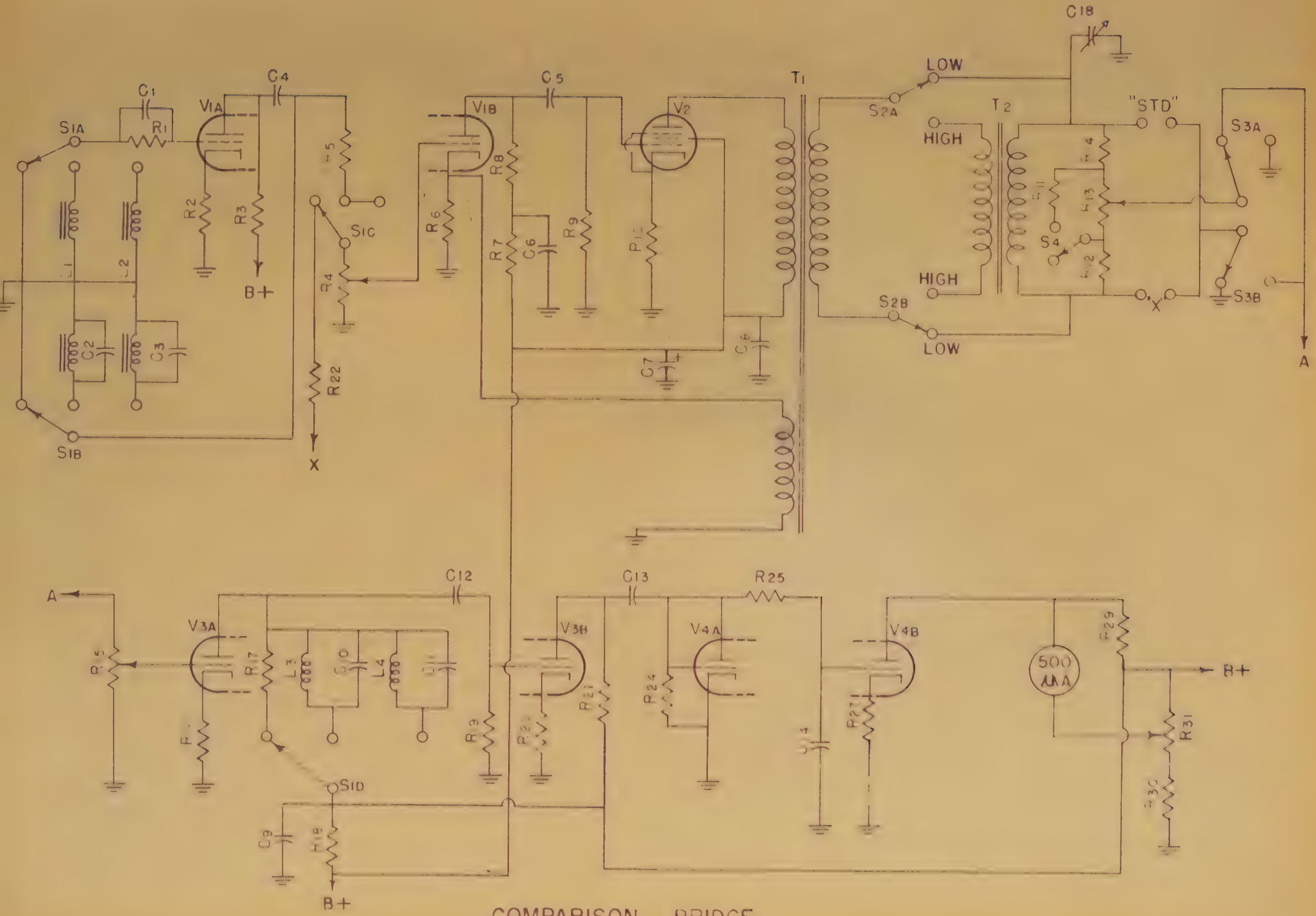
IMPEDANCE	FREQ	LEVEL=	BRIDGE	
RESISTORS				
1 OHM- 20 OHM	60CPS	LOW	POSITION #1	NOTE 1
20 OHM- 1 MEGOHM	60CPS	HIGH	POSITION #1	
1 MEGOHM-10 MEGOHMS	60CPS	HIGH	POSITION #2	NOTE 2
INDUCTORS				
10μH-100μH	10KC	LOW	POSITION #1	
100μH-100MH	10KC	HIGH	POSITION #1	
100MH-10 HENRY	1KC	HIGH	POSITION #1	
10HENRY-100HENRY	60CPS	HIGH	POSITION #1	
100HENRY-1000HENRY	60CPS	HIGH	POSITION #2	NOTE 2
CAPACITORS				
10MMFD-100MMFD	10KCS	HIGH	POSITION #2	
100MMFD-01MFD	10KC	HIGH	POSITION #1	
.01MFD-10MFD	1KC	HIGH	POSITION #1	
10MFD-100MFD	60CPS	HIGH	POSITION #1	
100MFD AND ABOVE	60CPS	LOW	POSITION #1	

NOTE 1 : WHEN OSCILLATOR GAIN IS IN MAXIMUM POSITION 1 VOLT IS APPLIED TO UNIT UNDER TEST. IN CASE 1 OHM RESISTORS ARE BEING MEASURED 1 AMP OF CURRENT WILL FLOW. CARE SHOULD BE TAKEN TO CHECK WATTAGE RATING OF LOW VALUES OF IMPEDANCES. ERRONEOUS READING (DUE TO HEATING EFFECT) OR DAMAGE TO COMPONENTS MAY RESULT.

NOTE 2 : IN POSITION 2 THE JUNCTION OF THE RATIO ARMS OF THE BRIDGE IS GROUNDED LEAVING BOTH TERMINALS OF THE STANDARD AND UNKNOWN UNGROUNDED. WITH THIS CONNECTION THE DIRECT IMPEDANCE BETWEEN TERMINALS OF A COMPONENT IS MEASURED, AND TERMINAL IMPEDANCES TO GROUND, WITHIN CERTAIN LIMITS, WILL NOT AFFECT THE BRIDGE BALANCE.



POWER SUPPLY FOR
"COMPARISON BRIDGE"



COMPARISON BRIDGE

FREED NO. 1010-A

PARTS LIST

RESISTORS

R-1	47K	1/2w	±10%
R-2	330 OHMS	1/2w	±10%
R-3	100K	1w	±10%
R-4	50K	2w	POTENTIOMETER
R-5	220K	1/2w	±10%
R-6	4.7K	1/2w	±10%
R-7	47K	2w	±10%
R-8	27K	1/2w	±10%
R-9	470K	1/2w	±10%
R-10	270 OHMS	1w	±10%
R-11	133 OHMS	2w	±1%
R-12	2K	2w	±1%
R-13	500 OHMS	% DIFFERENCE POTENTIOMETER	
R-14	2K	2w	±1%
R-15	2.5 MEG	2w	POTENTIOMETER
R-16	680 OHMS	1/2w	±10%
R-17	150K	1/2w	±10%
R-18	10K	1w	±10%
R-19	470K	1/2w	±10%
R-20	680 OHMS	1/2w	±10%
R-21	220K	1/2w	±10%
R-22	100K	1/2w	±10%
R-24	1 MEG	1/2w	±10%
R-25	470K	1/2w	±10%
R-27	27K	1/2w	±10%
R-29	27K	1/2w	±10%
R-30	100K	2w	±10%
R-31	20K	2w	POTENTIOMETER
R-32	1K	10w	±5%
R-33	500 OHMS	5w	±5%

CAPACITORS

C-1	.1 MFD	PAPER	200 VOLTS
C-2	.002 MFD	PAPER	200 VOLTS
C-3	.005 MFD	PAPER	200 VOLTS
C-4	.012 MFD	PAPER	200 VOLTS
C-5	.1 MFD	PAPER	400 VOLTS
C-6	15 MFD	ELECTROLYTIC	450 VOLTS
C-7	15 MFD	ELECTROLYTIC	450 VOLTS
C-8	10 MFD	ELECTROLYTIC	450 VOLTS
C-9	15 MFD	ELECTROLYTIC	450 VOLTS
C-10	.025 MFD	PAPER	200 VOLTS
C-11	.002 MFD	PAPER	200 VOLTS
C-12	.01 MFD	PAPER	400 VOLTS
C-13	.01 MFD	PAPER	400 VOLTS
C-14	.01 MFD	PAPER	400 VOLTS
C-15	10 MFD	ELECTROLYTIC	450 VOLTS
C-16	15 MFD	ELECTROLYTIC	450 VOLTS
C-17	15 MFD	ELECTROLYTIC	450 VOLTS
C-18	25 MMFD	VARIABLE, AIR	HAMMERLUND #117521

INDUCTORS

L-1-2	1010-A	SA1	OSCILLATOR COILS
L-3-4	1010-A	SA2	FILTER COILS

TRANSFORMERS

T-1-2	FREED # 24942	BRIDGE TRANSFORMER
T-3	FREED # 25166	POWER TRANSFORMER

SWITCHES

S-1	1010-A	MD12	4 POLE	3 POSITION	ROTARY
S-2	1010-A	MD10	2 POLE	2 POSITION	ROTARY
S-3	1010-A	MD10	2 POLE	2 POSITION	ROTARY
S-4	1010-A	MD11	1 POLE	2 POSITION	ROTARY

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